The public opinion climate for gene technologies in Canada and the United States: competing voices, contrasting frames

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This exploratory study of Canadian and US public opinion about gene technologies is based primarily on survey data collected by the Government of Canada, with media data from a widely available commercial database (LexisNexis) used in an illustrative case study of the apparent resonance between the climate of opinion and media frames in different regions of the two countries. The study uses regression modeling, factor analysis and cluster analysis to characterize the structure of the opinion data, concluding that observed opinion differences might be understood in terms of the greater number of individuals in the United States who belong to an identifiable opinion group that believes these technologies are benign and must be developed (termed, for convenience, "true believers"), as well as a somewhat greater number in Canada who belong to a group believing that ordinary people should be able to decide based on ethical considerations ("ethical populists"). However, the most common group in each country is made up of people who believe risks or costs and benefits should be weighed in developing policy, and that this should be done by experts ("utilitarians"). This group and two other cluster groups identified in the analysis ("moral authoritarians" and "democratic pragmatists") exist in roughly equivalent proportions in both countries, with some regional variation evident within each. While these observations represent descriptive findings only, they nevertheless underscore the complexity of the opinion climate and problematize the development of consensus policy. Preliminary analysis of news coverage of selected gene technologies revealed both similarities and differences in patterns of news discourse between Canada and the US. A sample of stem cell coverage for February 2004, following the American Association for the Advancement of Science meeting in Seattle (during which the announcement of new Korean research on human cloning was made), was used as a case study for a pilot media analysis.

1. Introduction

Canada shares much with the United States, including a very long and relatively permeable international border. Both countries are similarly diverse as to both geography and culture and are subject to many parallel influences and traditions, as well as to many influences and

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traditions that distinguish them. The reactions in each country to a variety of new gene technologies in both medicine and agriculture have been mixed. The opinion differences between them in this arena have been extensively documented elsewhere (Gaskel and Bauer, 2002; Pollara/Earnscliffe Research, unpublished survey reports). In general, Canada falls somewhere between the United States and Europe on the opinion spectrum for many of these technologies, but such generalizations offer little in the way of meaningful explanation of the differences and similarities between the two North American countries.

While demographic characteristics such as age, gender, education and so on do predict some of the variation in opinions regarding gene technologies in both Canada and the United States, they do not do enough to suggest the full spectrum of points of view that exist, they do not provide an optimally useful explanation of observed opinion differences, and they do not seem to capture the nature of these differences in a way that resonates with general observations of the political and social dynamics the issues invoke in each nation. In democratic societies, policy development tries to take public opinion into account. In the case of genetic technologies, public opinion is so mixed and variable that it is difficult to grasp how someone might do so.

To make the claim that opinion is mixed is not the same as claiming that opinion is fickle. Opinion researchers are apt to invoke the allegedly erratic nature of expressed opinion whenever available polls and surveys do not easily converge on the same characterization of what "people in general" are thinking, especially when the subject matter is technically complex. It is true that at the early stages of a complex technological development (or set of developments), the implications of which are as yet poorly understood, opinion might change fairly rapidly as new information is put forward. People are in the process of acquiring information and making up their minds. But education or knowledge are simply not strong predictors of attitudes and opinions in the area of gene technologies (Priest, 2001; Priest et al., 2003; Hallman et al., 2003). If researchers are to give up the "deficit model" of public opinion formation, which asserts that public opinion about science is largely a function of ignorance, what is to replace it?

It seems that knowledge of risks does not always deter adoption of technologies, any more than knowledge of benefits always ensures it. Simple contemporary examples make this clear. Ongoing uncertainty about medical effects has done little to alter a generally positive public response to cell phone use around the world; neither has an incomplete grasp of the technology that makes the system work. Rather, almost everyone seems to think these inventions are marvelous, if somewhat mysterious. Similarly, people almost everywhere drive cars, if they can afford to, without always understanding how their engines work. They do this despite broadly distributed knowledge of both the negative environmental effects of automobile use and the serious associated risks of accidental injury or death. Although some people in developed societies may give up using automobiles on a routine basis in favor of bicycles or walking out of a conscious commitment to environmental sustainability, the rejection of technology that has proved useful—even if risky—is not commonplace.

In both of these cases (cell phones and automobiles), compelling benefits are perceived to be associated with the technologies: instant communication and convenient transportation, respectively. Such benefits resonate with the value systems and lifestyles of individuals coping with contemporary society. Change in fundamental values comes slowly if at all, despite the technological change that surrounds us. It is these fundamental social needs and values that govern the adoption of new technologies, not necessarily technical knowledge of them. These everyday examples suggest that to gain perspective on the public adoption or rejection of gene technologies, we must look at the values and beliefs most closely

associated with responses to these technologies, not just whether people have scientifically accurate knowledge about them.

A variety of extensively researched cognitive and affective dimensions affect individuals' perceptions of technological risk (Slovic, 2000). Other research has identified personality and demographic characteristics of "early adopters" of newly introduced technologies (Rogers, 2003). However, the way that *socially distributed* values and beliefs affect the nature of public discourse and the formation of public opinion is not fully understood and deserves further exploration. For example, trust in certain kinds of social actors is a matter of social context and political climate, not simply the eccentric reactions and experiences of individuals, and in turn these patterns of trust are strong predictors of responses to biotechnology on the national level (Priest et al., 2003).

Cultural theorists writing on risk, such as Douglas and Wildavsky (1982), have attuned us in a general way to the idea that risk has cultural dimensions that might partially explain why ordinary people sometimes differ from experts in their understandings of risk, and why members of different cultures may also differ from one another, but do not often confront the issue of how lay (non-expert) members of society may themselves vary in their perspectives. Beck (1992), in arguing for the centrality of risk exposure as an organizing principle in contemporary society from a perspective informed by classical sociological theory, comes closer to appreciating the complexity of public responses among groups as well as at the individual level. While scarcely present in academic discussions of risk, however, the application of cultural theory to the interpretation of media messages has often focused on this very issue of group dissent. As Hall (1980) is usually credited with first noting, responses to media representations are not always hegemonic but can also reflect various forms of resistance related to identification with oppositional subcultures. While the analysis presented here uses the methods of inductive statistics to define group differences that may or may not reflect consistent or meaningful subcultural identities, the result is not inconsistent with Hall's key observations.

The study reported in this article rests on a position that rejects both the reduction of opinion to a characteristic of individual psychology and the reduction of risk debates to stand-offs between scientific or technocratic experts and a presumably homogeneous "lay public." The truth (especially in culturally pluralistic societies such as the US and Canada) is much more complex. Within particular societies, the existence and visibility of *subcultural* groups characterized by shared values and beliefs changes the climate in which individual opinions are formed, lends expression to collective views, and shapes the formation of public discourse. Individual characteristics, including values and beliefs, may determine individual decisions, but they do so in a climate of opinion in which the individuals involved situate themselves (psychologically) with respect to reference groups with whom they identify. At the same time, the larger culture and its institutions, including the news media, recognize some of these perspectives as legitimate while others are rendered as marginal.

The dynamics of collective behavior, in other words, are not reducible to *individual-level* cognition, affect, attitudes, values or beliefs, but depend on both culture and social structure (including the activities of key institutions and actors such as scientists, media, regulators, and so on) as well. At the other extreme, the *aggregate* results of public opinion surveys over entire populations may be instrumentally useful and yield some valuable insights, but they do not very well reflect the collective dynamics of public opinion, how it varies and how it might be formed and expressed. In fact, the nature of survey research itself has been criticized for reducing citizens to isolated consumers, using biotechnology as a case in point (Davison et al., 1997). But in this study public opinion data are used in a

different way, to help document the existence of groups within society that may or may not accept dominant interpretations, including those reflected in news media.

This article is thus intended to demonstrate the way in which Canadian–US similarities and differences in public opinion on gene technologies might better be represented by subdividing the populations of the two countries into groups or clusters with a strong degree of attitudinal similarity, rather than conceiving of them as monolithic wholes that begin and end at the shared border between the two countries. It also provides a preliminary analysis of news media coverage that uses the existence of these defined attitudinal perspectives as an analytical tool to understand variations in media treatment of the associated issues and perspectives. Media analysis is an important adjunct to opinion studies *not* because media directly determine (or ever fully reflect) public opinion, but because media accounts express relevant values and beliefs, help confer legitimacy to or discredit particular groups by treating them as part of the mainstream or as marginal, and therefore indirectly affect which perspectives do or do not ultimately come to dominate collective discourse and decision-making.

Although much of the foregoing discussion may be of theoretical interest primarily, it informs an analysis that is focused on practical concerns of democratic governance. Public opinion cannot be taken into account if it cannot be meaningfully grasped. Both the opportunities and the obstacles to achieving democratic consensus are more apparent when the complex dynamics of the opinion climate are made more apparent. While it may turn out that some value- and belief-based opinion differences with respect to gene technologies are simply irreconcilable, the hope is that this interpretive analysis will suggest opportunities for consensus, as well as better characterizing discord. However, the particular opinion groupings presented in this article are undoubtedly artifacts of the particular survey questions posed and should not be accorded a significance—particularly a political or social status—that they do not deserve. The relationship between membership in these groups and visible, traditional divisions into race, class and gender groups or political or religious affiliations (and so on) remains unclear. At the same time, however, the statistical analysis presented here suggests that attitudes toward risky technologies cannot be reduced to simple demographic explanations.

2. Competing voices: opinion clusters

Opinion, attitude and demographic information from about 1,500 randomly selected telephone survey respondents, roughly two-thirds of them in the United States and one-third in Canada, form the basis of this reanalysis. This 2003 survey dataset[1] facilitated the identification of opinion cluster groups useful for grasping contrasting opinion dynamics in Canada and the United States. As part of the strategy adopted for this analysis, three examples of controversial genetic technologies were identified for special attention: genetically modified (GM) foods, stem cell research, and genetic privacy. These three cases were selected as representative of the broad range of biotechnology issues with which the public is presently being confronted in the news media.

The oldest of these areas, that of GM food controversies, is a long-standing and fairly well-understood set of issues in both Canada and the US, one that interests a broad variety of stakeholders vis-a-vis food production: seed companies, large farms, small farms, pesticide producers, environmentalists, scientists whose funded research is in this area, organic farmers and their customers, and—of course—food consumers generally. Recently visible GM controversies have involved such things as the alleged spread of modified

genetic material in corn across much of Mexico, the appearance of GM fish in pet stores, and the accidental dispersion of experimental GM crops into the general food supply. While GM crops are "old news" by now, potential public response to food made from cloned or genetically engineered animals is an emerging area of interest.

Stem cell research for medical application is a very different technology and one that has become visibly controversial more recently. Currently, advances in human stem cell research rest on the prospects for cloning human embryos to extract these cells, although alternatives involving the use of adult stem cells are also being explored. The embryo cloning procedure is highly controversial for those who object to abortion and has therefore been strongly opposed by the Bush administration in the US, which has withdrawn federal research funding for those engaged in related activity while allowing research with preexisting stem cell cultures (or "lines") to continue. Because of the association with cloning, this technology may also be controversial among other constituencies who fear individuals might try to use cloning technology to make genetic replicas of themselves or family members. Researchers have taken pains to distinguish this latter kind of "reproductive" cloning from the "therapeutic" cloning intended to advance scientific knowledge and improve medical treatment for a variety of diseases, despite close technical similarity between the two areas of research.

The Human Genome Project promises to present new challenges in the area of genetic privacy, an emerging and potentially controversial area that does not involve active manipulation of DNA but "only" the management of personal information. Potentially, this could include information about susceptibility to hereditary or partially hereditary diseases, as well as identifying information collected in criminal cases that might possibly be subject to misuse or abuse. In future, for example, insurance companies and employers might request genetic testing of potential clients and employees, or might seek to obtain the results of previous tests from government databases. While knowledge of the human genome is believed to hold great potential for improving human health, particularly with respect to inherited susceptibility to disease, this area is also seen as fraught with emerging public policy controversies. The US–Canada survey dataset used in this study included questions specifically about the Human Genome Project that were included in the analysis.

Multivariate analysis

Opinions on these three issues—GM foods, stem cells, and human genome studies—were dependent variables used in an analysis testing a broad range of available data as potential predictor variables in a sequence of multivariate analysis steps as described below.

Step one: factor analysis. The 2003 survey included a series of 15 questions that pertained to general attitudes toward a variety of gene technology issues and applications, all of which were answered on a four- or five-point scale. For example, one question asks for degree of agreement with the statement, "Biotechnology research represents the next frontier of human endeavor," and another asks for degree of agreement with the statement, "We have to accept some risk to achieve the benefits of biotechnology like new foods that contain vitamins or medicine." This series elicited general attitudes rather than specific opinions. Factor analysis was first used to reduce answers to these 15 attitudinal questions to a limited number of underlying dimensions.[2]

The results of the factor analysis suggested two dimensions were of interest, one that might best be described as "resistance" and one that might be described as "realization" (Table 1). Respondents who scored higher on the "resistance" factor tended to disagree with

statements describing a major role for biotechnology in the future, its inevitability, and the desirability of national leadership in this area, and they tended to disagree as well with assertions of the benefits of biotechnology. Respondents who scored higher on the "realization" factor tended to seek realization of the potential benefits of biotechnology and reject the idea that government regulation should be allowed to slow down this realization or that ordinary people should decide. As factor analysis infers dimensions that are statistically unrelated, the presence of "resistance" does not imply the absence of "realization." Rather, the two factors represent two different, statistically distinct dimensions of thinking that appear to be reflected in the patterns of respondents' answers to the entire series of questions.

Step two: risk perceptions. It might be possible for reactions to gene technology and its associated risks and benefits to reflect a more general orientation to risk. In other words, those who greatly fear the impact of gene technologies on health or the environment (and so on) might be those who greatly fear other such influences. Therefore, in this analysis, four indicators of risk perception were developed from nine questions included on the survey about a variety of risks. These nine questions were grouped into three types: environmental risks, risks of disastrous events, and bio-related risks, plus risk associated with drinking water (which did not correlate well with any single group and was treated separately). Appropriate indexes of general levels of perceived risk were constructed based on the answers to these risk questions (Table 2).

Step three: regression models. The third step was to develop regression models in which levels of support for each of the three technologies of special interest (GM foods, stem cell research, and the Human Genome Project) were treated as dependent variables. The goal of

Table 1. Factor analysis defining "resistance" and "realization" dimensions

Question		Factor loading	
		Factor 1 ("resistance")	Factor 2 ("realization")
22[a]	Biotech has benefits (drawbacks) to people's health	.641	–.170
23[a]	Biotech has benefits (drawbacks) to national economy	.569	–.139
24	Government should slow biotech until risks known	–.531	.460
25	GM food presents few benefits, many risks	–.500	.588
26	GM health products present few benefits, many risks	–.431	.655
27	Biotech is next human frontier, will enhance life	.774	.131
28	Biotech is next advancement wave, like info tech	.692	.219
29	Nation (Canada or US) is among world leaders in biotech	.435	.232
30	Nation (Canada or US) should be among world leaders	.704	.143
31	Long-term safety research would make me comfortable	.636	.138
32	Biotech is part of future, despite unknown risks	.668	.199
33	Should accept risks to get health benefits (diagnosis, cure)	.659	.201
34	Should accept risks to get new foods (with health benfits)	.712	.117
35	Governments should inform people, let them decide	.093	.561
36[a]	Biotech should be allowed if science says it is safe	.668	.097

Note: Component matrix loadings resulting from principal component analysis on survey data provided by the Canadian Biotechnology Secretariat. Entries represent the relative contribution of each variable to each of the two factors. In interpreting this table, note that in all cases higher positive numbers represent *dis*agreement with the statements in question, in accord with the question wording used in the original survey.

[a] Indicates three questions that were asked in two different forms. This analysis used combined results in each case.

Table 2. Risk-related questions contributing to index construction

	Canada	United States
Bio-related risks		
GM foods	4.44	3.68
Bio-pharmaceuticals	4.06	3.56
Event risks		
Car accident	5.08	5.14
Violent crime	4.90	4.82
Severe weather	3.94	3.84
Environmental risks		
Air pollution	5.22	4.80
Pesticides	5.09	4.68
Nuclear waste	5.36	5.08
Drinking tap water[a]	3.60	3.49

Note: Mean degrees of risk perceived among Canadian and US respondents based on seven-point scales used in survey.
[a] Treated separately; largely uncorrelated with any one risk category.

regression analysis is to determine which variables of an available set are the best statistical predictors of the dependent variables of interest, in this case support for each of the three technologies. Independent variables in this analysis included the two factors, the three risk perception indexes, in which country the respondent resided, relevant demographics (such as age, gender and educational level), general reactions to the words "biotechnology" and "technology," preference about whether ordinary people or experts should make relevant decisions, and opinion about whether the decisions should be based on ethical considerations or weighing of risks and benefits. In short, all items that seemed to hold any promise of predicting opinions about specific gene technologies were "candidate variables" in the regressions.

Three separate regression analyses were developed (Tables 3, 4 and 5) corresponding to each of the three technologies of interest. Those variables that were the best predictors of whether a respondent believed that GM food provided few benefits but more risks were the two factor analytic dimensions ("resistance" and "realization") and fear of other biological risks (Table 3). The adjusted R^2 for this analysis was .599, meaning that about 60 percent of the variance in GM attitudes was attributable to these predictors.

Those variables that were the best predictors of whether a respondent believed that stem cell research was acceptable were whether the decision should be based on ethics or on risks and benefits, factor score one ("resistance"), and to a limited extent four other items (household income, belief that government was doing an effective job monitoring biotechnology, gender, and whether experts or ordinary people should decide) (Table 4). The adjusted R^2 for this analysis was .201, meaning that just over 20 percent of the variation in approval of stem cell research was attributable to these predictors.

Finally, approval of the Human Genome Project (mapping human DNA) was best predicted (in order) by factor score one ("resistance"), whether experts should decide, fear of other biological risks, familiarity with biotechnology, and whether the decision should be based on ethics or on risks and benefits (Table 5). These five factors accounted for only about 10 percent of the variance (adjusted R^2 of .097) for this variable.

Table 3. Regression analysis results for GM food issue

Independent (predictor) variable	Standardized beta coefficient	Significance
Factor score 1 (“resistance”)	.563	.000
Factor score 2 (“reslization”)	–.476	.000
Bio-related risk perception index	–.065	.014

Note: Analysis used question about whether GM food presents few benefits but more risks than non-GM food (Q25) as dependent variable in stepwise regression. Results show only those variables included in the final model, that is, only those independent variables that best predict variation in the value of the dependent variable. Overall adjusted *R*-squared was .599; overall significance of model .000. Higher numerical value indicates less agreement with statement.

Table 4. Regression analysis results for stem cell research issue

Independent (predictor) variable	Standardized beta coefficient	Significance
Basis of decision (Q38A,B composite)	.250	.000
Factor score 1 (“resistance”)	.262	.000
Household income (Q70)	–.077	.021
Government effectiveness (Q42)	–.078	.020
Gender (Q73)	.072	.028
Who should decide (Q39)	.071	.038

Note: Analysis used question about how acceptable stem cell research should be in respondent’s country (Q55) as dependent variable in stepwise regression. Results show only those variables included in the final model, that is, only those independent variables that best predict variation in the value of the dependent variable. Overall adjusted *R*-squared was .201; overall significance of model .000. Higher numerical value indicates less acceptability.

Table 5. Regression analysis results for issue of mapping human DNA

Independent (predictor) variable	Standardized beta coefficient	Significance
Factor score 1 (“resistance”)	.149	.000
Who should decide (Q39)	.102	.006
Bio-related risk perception index	.121	.002
Familiarity (Q4)	.077	.030
Basis of decision (Q38A,B composite)	.077	.036

Note: Analysis used question about whether mapping the human genome provides more benefits than drawbacks (Q58) as dependent variable in stepwise regression. Results show only those variables included in the final model, that is, only those independent variables that best predict variation in the value of the dependent variable. Overall adjusted *R*-squared was .097; overall significance of model .000. Higher numerical value indicates perception of drawbacks outweighing benefits.

It is important to note that each of the three applications produced distinctly different models (that is, people seem to apply different reasoning in each case), and that these differences seem to be intuitively meaningful rather than arbitrary. While the percent of variance explained in the regression model for GM food is unusually high, *all* of these results are statistically significant ($p \leq .000$ in each case).

Step four: cluster analysis. Finally, the variables that were among the strongest predictors in any one of the three regression models described in step three above were entered into the two-step cluster analysis routine provided by the SPSS software, a routine that can handle both categorical and continuous data. The routine created five respondent clusters as described in the following subsection.

Cluster results

This procedure yielded five subgroups that can be thought of as characterizing the overall dataset generated from all 1,500 respondents in both countries. These subgroups are described one by one in this subsection, with additional information about their other preferences. It is important not to "reify" such groupings by supposing that all individuals fit neatly into one or another of the groups, as though they were members of exclusive clubs or wore unique identifying labels. Not all individuals placed within each group share all the opinions of the group. Nevertheless, these groups are useful for comprehending the nature of opinion in this complicated area of public discussion, and they will also inform the media analysis that will be reported below. Further, and perhaps most importantly, the differences in opinion between the US and Canada can be usefully conceptualized as resulting from unequal distributions among these five groups within each country.

True believers. Members of this group see very little risk in biotechnology and are especially anxious to reap its benefits. They have a very low level of resistant attitudes and believe policy should be set by experts on the basis of risk–benefit considerations. They are highly supportive of the Human Genome Project, stem cell research and GM foods. They tend to be younger, be more highly educated, have a much higher income, and more commonly (over 60 percent) be male. *These make up only about one-tenth (11 percent) of the Canadian population but nearly one quarter (24 percent) of those in the US*. This difference is important and seems consistent with the oft-made observation that US culture in general is strongly supportive of science and technology.

Utilitarians. This group agrees with "believers" that experts should set policy based on risks and benefits, but sees risks as high and are less convinced that benefits must necessarily be pursued. They generally hold mid-range levels of resistant attitudes. They tend to see the risks of GM foods as outweighing the benefits but are generally supportive of the Human Genome Project and stem cell research. They also generally see non-biotechnology-related environmental risks as high, especially compared to "believers." This group is about average in age and education; somewhat above average in income; and evenly distributed as to gender. *These are the most common group in both the US and Canada at just under 30 percent.* This distribution is somewhat surprising, perhaps because greater attention in Canada to "precautionary" and pro-environment policies (in the context of their relatively lower visibility in the US) creates the expectation that a higher percentage of Canadians than US residents might adopt this perspective. But this is not the case.

Moral authoritarians. These individuals believe that policy should be based on ethical considerations but must be decided by experts. They see biotechnology's risks as mid

range to high and have mid-range levels of resistant attitudes and approximately mid-range desire to realize benefits, on average. Generally they are in favor of the Human Genome Project but divided on stem cell research (lean toward) and GM foods (lean against). They hold about average perceptions of other (non-biotechnology) risks. Slightly above average in age and education and average in income, this group is disproportionately female. *This group is around one-fourth of the population in both Canada and the US (slightly higher in Canada).* It is important to remember that the "authoritarians" are not an anti-biotechnology group, but they are divided on two of the three issues.

Democratic pragmatists. Like moral authoritarians, these see risks as mid range to high and have mid-range levels of resistant attitudes, about mid-range desire to realize benefits, and roughly average perceptions of other (non-biotechnology) risks. But they believe policy decisions should be based on risk and benefits (rather than ethical considerations) and determined democratic (rather than made by experts). They tend to support the Human Genome Project, stem cell research, and GM foods. They are younger, a bit less educated, with income somewhat below average, and are disproportionately male. *This is the smallest group overall and about equally common (around 12 percent) in both the US and Canada*.

Ethical populists. Those in this group believe ethics should control policy but that average people should be the ones deciding. Perceived risks of biotechnology are high; perceptions of non-biotechnology risks are slightly elevated. This group has the highest levels of resistant attitudes and the lowest emphasis on realizing projected benefits. They lean toward the Human Genome Project but by the lowest margin. They are divided on stem cell research and lean against GM foods. This group tends to be older, less well educated, and lower income; both genders are represented about equally. *This group makes up one-eighth (13 percent) of the US population but one-fifth (21 percent) of Canadians.*

The attitudinal groups that seem to account for observed opinion differences between the United States and Canada are not those who appear to be following utilitarian logic, those listening to the voice of moral authority, or those who want risks and benefits weighed in a democratic process. Rather, two relatively small but uniquely distinctive groups seem to account for the opinion differences. "True believers," who have the strongest commitment to biotechnology and do not see it as especially risky are more common in the US, while "ethical populists," who have the strongest resistance to biotechnology and may see it as morally problematic (as well as risky) are more common in Canada. However, the majority of the population across both North American countries is not in either of these groups, suggesting that for many people opinion formation dynamics might be similar on both sides of the border.

Statistically, it is attitude cluster membership rather than country of residence that best predicts support for (or opposition to) the particular applications tested (Table 6). However, "moral authoritarians" in the US are more likely to be opposed to stem cell research and the Human Genome Project but more likely to be supportive of GM foods in comparison to Canadian "moral authoritarians."

In addition, there are intriguing geographical differences in the distribution of the cluster membership in each country (Table 7). All clusters are found in all regions of each of the two countries. However, in Canada, "utilitarians" are most common in the east, "ethical populists" in the prairies, and "moral authoritarians" in British Columbia. In the United States, "utilitarians" are most common in New England, the Western Plains, and the Pacific

Table 6. Cluster group membership and issue-related opinion

	Mean response to key survey items		
Cluster identifier[a]	Q25 GM food[b]	Q55 Stem cell[c]	Q58 DNA mapping[d]
1. True believer	3.08	1.60	1.05
2. Utilitarian	2.27	1.91	1.23
3. Moral authoritarian	2.26	2.43	1.23
4. Democratic pragmatist	2.25	2.09	1.29
5. Ethical popularist	2.08	2.77	1.52

Note: Clusters were created using SPSS® two-step cluster routine and variables identified in any of the regression models in Tables 3, 4 and 5 as predictor variables.

[a] See text for more complete description of these respondent clusters.

[b] Lower number = agree few benefits, more risks.

[c] Lower number = more acceptable to do this research.

[d] Response 1 = more benefits than drawbacks; 2 = more drawbacks.

Rim. "True believers" are most common in the Midwest and the Southwest, while "moral authoritarians" are most common in the South. This distribution appears to resonate with the cultural geography characteristic of each country.

3. Media analysis

A goal of this project was to determine the extent to which these disparate voices, whose presence is suggested by this interpretive analysis of the survey data, might or might not

Table 7. Geographical distribution of cluster group membership

	True believer[a]	Utilitarian	Moral auth	Demo prag	Ethic pop
Canadian regions:					
Atlantic ($N = 20$)	10.0%	**45.0%**	10.0%	15.0%	20.0%
Quebec ($N = 62$)	9.7%	**24.2%**	**24.2%**	19.4%	22.6%
Ontario ($N = 94$)	10.6%	**33.0%**	25.5%	13.8%	17.0%
Prairies ($N = 20$)	15.0%	20.0%	25.0%	0.0%	**40.0%**
Alberta ($N = 25$)	16.0%	20.0%	**28.0%**	8.0%	**28.0%**
BC/Terr ($N = 32$)	6.3%	34.4%	**40.6%**	6.3%	12.5%
Overall Canada	10.7%	**29.6%**	26.1%	12.6%	20.9%
US regions:					
New Eng ($N = 146$)	22.6%	**32.2%**	19.9%	15.1%	10.3%
Old South ($N = 131$)	21.4%	25.2%	**29.8%**	11.5%	12.2%
Midwest ($N = 124$)	**26.6%**	25.0%	24.2%	8.1%	16.1%
W Plains ($N = 32$)	21.9%	**37.5%**	31.3%	6.3%	3.1%
SW/Des/Mt ($N = 75$)	**29.3%**	22.7%	14.7%	16.0%	17.3%
Pac Rim ($N = 94$)	23.4%	**30.9%**	22.3%	8.5%	14.9%
Overall US	24.1%	**28.1%**	23.3%	11.5%	13.1%

Note: Clusters are the same as those used in Table 6. Regions follow those used in original survey coding. Boldface indicates modal cluster present in each region; however, note that some areas have very small numbers of respondents represented (N).

[a] See text for more complete description of these respondent clusters.

dominate media coverage in particular areas. While media coverage does not by itself set agendas or form opinions, it is an important influence on perceived issue significance and the perception of what constitutes mainstream versus "fringe" opinion. Such perceptions do influence public discourse and potentially affect the outcome of public debate, even without changing privately held opinions, by contributing to general impressions of "what people think" among both politicians and ordinary citizens.

This portion of the analysis should not be interpreted as representing scientific measurement of media content, even where frequency data have been generated. However, the analysis was as systematic as possible and relied on a widely recognized comprehensive commercial database of news stories available at most academic libraries.[3] As a preliminary step, a brief count of articles published from January 2003 through February 2004 for Canada[4] and four US regions was derived from searching for the keywords "stem cell," "genetic privacy," and "genetic" with "modified" for each of the 14 months (Table 8). It is noteworthy that "genetic privacy" pulled up very few articles for either country, suggesting it is simply not a lively public issue right now, while "genetic" with "modified" pulled up only about as many pieces in the entire United States as in Canada. While vocabulary may be an issue (the phrase "genetically modified" may be less common in the US), this also resonates with the observation that GM foods may be less actively controversial in the United States than elsewhere in the world, including Canada. It is also worth observing that patterns of attention in both countries appear closely related for all three issues, suggesting they are probably responsive to similar events.

The second step of the analysis looked more closely at the same material for the most recent month (February 2004), using all articles containing the keywords "genetic privacy" (of which there were relatively few available) and a selection of articles using the other two sets of keywords. The selection process made use of the idea of a "constructed week" as a sampling device: those articles published on Sunday 1 February, Monday 9 February, Tuesday 17 February, Wednesday 25 February, Thursday 5 February, Friday 13 February, and Saturday 21 February were included. As newspapers tend to publish different kinds of stories, this kind of sampling—while, again, not especially "scientific"—is considered better than probability sampling that might overweight a particular day of the week. As it turns out, the week of Friday 13 February was the week of the annual meeting of the prestigious American Association for the Advancement of Science, taking place in Seattle, during

Table 8. Initial distribution of LexisNexis articles obtained from keyword searches

	2003												2004	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb
Genetic privacy														
Canada	18	12	10	13	13	22	8	15	16	28	22	3	24	4
US	58	34	41	62	33	48	48	28	23	70	25	39	40	28
Genetic + modified														
Canada	132	96	120	108	180	227	172	142	117	136	74	89	105	63
US	108	136	120	99	166	216	155	97	76	105	101	76	99	74
Stem cell														
Canada	200	115	108	145	120	221	122	69	113	196	151	99	86	167
US	394	292	335	305	374	304	300	217	300	322	332	295	269	423

Note: Distribution follows similar temporal patterns in the two countries for all three issues; however, the *ratio* of US to Canadian articles found is substantially greater for genetic privacy and stem cell articles, indicating relatively more ongoing attention to genetically modified food issues in Canada.

which a team of Korean scientists announced having cloned a human embryo. Their results were also reported in *Science* magazine. The purpose of their experiment was to obtain embryonic stem cells, and thus the stem cell coverage was particularly rich during this period.

Finally, these sampled stories were read, analyzed and categorized by the researcher as emphasizing one of the points of view suggested by the cluster analysis. News stories appealing to the progressive nature of science, opposition to regulation, or discussions of benefits but not risks were considered expressions of the "true believer" perspective. Stories discussing risks and weighing them against benefits, analyzing uncertainties, or concerned primarily with social, health, environmental or other potential negative impacts were considered expressions of the "utilitarian" perspective. Stories appealing to religious or other moral/ethical authority, including court proceedings in which judges or attorneys were making decisions on behalf of society and most stories dominated by comments from academic ethicists, were considered representative of the perspective of "moral authority." And stories appealing to democratic processes or looking at what ordinary people think (whether or not reflected in formal opinion polls) were considered "populist" or "pragmatist" in their orientation, a perspective so rare that these two categories were combined for purposes of the media analysis.

As is common in content analysis of this type, stories that turned out to have no relevance to the subject of study but that appeared on the basis of keyword designations needed to be excluded, as were stories that were nearly exact repeats or reprints of other stories. However, all other stories—including letters to the editor, editorials, press releases, and stories making only a passing mention of one of the gene technologies being studied—were included. This form of content analysis, while highly systematic, should be considered a form of qualitative research due to the inherent subjectivity of the classification process. It is likely that another analyst would have classified some stories differently.

Altogether, approximately 144 news stories across the three issues and two countries were carefully read and classified, yielding a foundation on which to interpret the status of public discourse on these issues in North American news media for the month of February 2004 (Table 9).

For the topic of genetic privacy, only 13 articles were located during the entire month (not sampled), of which only two were Canadian. All four attitudinal perspectives were represented in this small sample of articles; however, additional data would be required to suggest any conclusion beyond the self-evident fact that news media are simply not covering these issues. Typically, media coverage is event driven and if advocates, legislators, or others are not calling attention to an issue it will not receive much news attention, especially when it is an abstract or technical one not set in the context of a particularly compelling case. Genetic privacy is a good example of an abstract issue unlikely to make news unless significant actors make this happen.

For GM foods, "utilitarian" arguments appeared dominant in 10 of the 17 Canadian stories in the sample, as well as in five of the nine articles collected for the United States. This suggests that US discourse is no longer dominated by promotional representations (at least on the basis of this very small sample) but has come to resemble US public opinion as being more balanced in this area, a finding consistent with other research on US media trends (Priest and Ten Eyck, 2003). However, it is also consistent with the observation that this issue is simply not as active a public controversy in the United States as in Canada. Nevertheless, several of these US articles included discussions of the risk of negative consumer reaction or concerns over inability to export GM products, suggesting awareness

Table 9. Classification and distribution of articles from keyword search of LexisNexis database: results from February 2004

	True believer	Utilitarian	Authoritarian	Popular[a]	DK[b]
Genetic privacy (entire month)					
Canada	0	0	**1**	**1**	0
US	**4**	**4**	1	1	1
All	**4**	**4**	2	2	1
Genetic + modified (single constructed week only)					
Canada	2	**10**	0	1	4
US	1	**5**	1	1	1
All	3	**15**	1	2	5
Stem cells (single constructed week only)					
Canada	2	1	**6**	0	2
US Midwest[c]	**10**	2	2	0	3
US Northeast	**10**	5	6	1	9
US Southeast	**9**	3	7	0	4
US West	**11**	4	3	1	4
US total	**40**	14	18	2	20
All	**42**	15	24	2	22

Note: Categories assigned qualitatively, based on predominant perspective suggested through topic, sourcing, framing.

[a] Combines democratic pragmatist and ethical populist.

[b] Not readily classifiable.

[c] Follows LexisNexis categories, which differ from survey region codes.

(concentrated in the "true believer"-dominated agricultural Midwest) of GM foods' controversial nature.

For stem cells, the picture is more informative because of the larger number of articles analyzed, 11 in Canada but 94 in the United States. (In addition, several Canadian stories about the Korean cloning research announced in Seattle were widely reprinted and while they were therefore largely excluded from the sample as duplicate stories, this suggests the wider general publicity this issue was receiving.) Of the Canadian stories, over half (six) were classified as "moral authoritarian" in perspective, with extensive discussion of both ethical issues and the need for regulation. However, of the US stories that could be classified, well over half represented "true believer" accounts (40 out of 74 classified stories, with 20 out of the 94 unclassifiable[5]). These included projections of the medical potential of stem cell research, profiles of individual disease victims who might be helped, and discussions of the need for US research to be free to remain competitive with that of the rest of the world.

If only because of the efforts of research advocates (including publicists from research-oriented organizations and institutions), "true believer" accounts are clearly dominating the news in this area. Using the regional divisions adopted by the LexisNexis system, this is true in the Midwest (10 out of 17 stories), the Northeast (10 out of 31 stories), the Southeast (nine out of 23 stories), and the West (11 out of 23 stories). However, only in the Southeast (which in this case includes the South, again following LexisNexis regional classification criteria) did the number of calls for moral authority approach the number of "true believer" perspectives, likely illustrating the ongoing influence of the disproportionate presence of this group in this particular region of the country.

4. Discussion

In the period chosen for the media analysis, the most visible voices in the media are clearly the pro-science advocates of stem cell research, though they are much more apparent in the United States (where current federal policy discourages the research and has sometimes made activists of scientists) than in Canada. In the conservative southern US these "true believer" voices are certainly somewhat less dominant, however. The media data analyzed, which represent only a pilot study focused primarily on the stem cell case, cannot be taken as definitive. No claims are being made about a simple cause-and-effect relationship between the distribution of opinion groups in a region and the distribution of voices prominent in news accounts. But these results are certainly illustrative of the way that media coverage consistently reflects visible events and the perspectives of vocal spokespersons rather than "general" public opinion, while at the same time resonating with culturally significant themes that are not always fully shared.

In the United States, as of February 2004, the voices being heard in the news were primarily voices in favor of stem cell research, rather than the voices of those who object, but the distinct dynamics in Canada and the southern region of the United States remind us that ethical objections remain. The Seattle cloning story released in February and widely reported as a scientific "breakthrough" was in part reframed as a call for renewed attention to ethical issues in some reports. Perhaps more aggressive public debate will eventually help resolve some of the public opinion challenges, but (despite the dominance of "true believer" voices) consensus is likely to remain illusive. Stem cell research has been the subject of active lobbying efforts from US medical and research communities, arguably resulting in the heightened visibility of "true believer" perspectives and possibly inducing a public opinion shift, but the longer term public opinion outcome remains uncertain.

On the GM food issue, the US news accounts are no longer so heavily promotional as they once were, but the issue has all but died out as an active public controversy. The controversy continues more actively in Canada. Genetic privacy does not appear to be getting much of a hearing in the news media in either country.

These results, while again only suggestive and based on limited data, are consistent with what is known about the complex relationship between public opinion and media coverage. News accounts can over-represent activist voices, sometimes creating the illusion of polarization where it does not actually exist and sometimes creating the impression that a particular view dominates more than it actually does. Gene technologies are no exception, and news about them is illustrated here to have been driven largely by advocacy perspectives from the scientific community, though this varied by country and region. Naturally, had another issue been highlighted during the month chosen for analysis, the specific outcome would have been different, but the dynamics of event- and interest-driven news that focuses on a few powerful voices would in all likelihood be the same.

Finally, one of the most striking aspects of the media data is that the populist and pragmatist groups who want ordinary people to have a say on gene technology issues are nearly invisible (and thus potentially less influential in public discourse). Only about a half dozen of 144 articles examined called for or reported on popular views (as opposed to the views of individual scientific experts, ethicists, politicians, activists, and other leaders). This reflects the news media's source dependency, which results in journalistic inclusion of powerful voices that demand action and attention but in effect disempowering others. Those who speak out most loudly on controversial issues are not always representative, especially of moderate opinion. Quoting experts is also both easy (a normative journalistic routine) and safe (ironically, it protects the journalist from being accused of taking sides).

Of course, it is a matter of political philosophy whether every controversy, particularly those involving emerging science and technology, should be put to some kind of a vote or even be the subject of public debate. This looms as a particular challenge for public policy in the coming decades, as the issues are likely to become more and more technical and complex. It also looms as a strategic problem for those who want to promote new science and technology, whether for commercial or humanitarian ends. Ignoring rather than addressing popular objections can invite vigorous backlash reactions, as has been the case for both GM foods and stem cell research—though these seem to have involved very different political constituencies. By making dissent visible and enabling informed public debate, the news media can simultaneously empower ordinary people and contribute to a healthy democratic society. However, the media's dependence on visible events and vocal spokespersons makes it hard to realize this potential.

This project has suggested that the differences between the United States and Canada in terms of public opinion regarding particular genetic technologies may be best understood in terms of identifiable attitudinal clusters with distinct geographic distributions, distributions that resonate with available media data. It is difficult to claim that this particular analysis would hold across a wider set of issues, especially as it is dependent on answers to a particular set of survey questions and event-driven media stories appearing at a given point in time. Surveys may not adequately represent "public opinion" by any definition, and the media data included here only illustrate dynamics that are believed to exist more generally. However, the alternative views illustrated by these data do appear to have deep roots that do not stop at national borders and deserve more careful attention. Public opinion research about technology and its adoption needs to be better integrated with social and cultural theories of risk. Equally deserving of attention is the ongoing search for new methods of incorporating such widely divergent views into public discussions, media representations, and societal decision-making in a meaningful way.

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Notes

1 These data were presented in the March 2003 "Eighth Wave Summary Report" on public opinion submitted from Polara/Earnscliffe Research to the Biotechnology Assistant Deputy Minister Coordinating Committee of the Government of Canada.

2 In this and all other statistical analyses described in this report, commercial SPSS® statistical analysis software (version 11.5) was used, with default settings.

3 The "LexisNexis Academic" database.

4 Actually this portion of the analysis included all North American, non-US sources. As the database is limited to English language news, this was almost exclusively from Canada. The database is not necessarily compre-

hensive; only sources giving their permission to the database company can be included, for example. However, this database is commonly used for content studies and is not known to contain major systematic biases.

5 Some excellent news stories by traditional journalistic standards were "unclassifiable" because they were well balanced and included a variety of issues and views, rather than falling into one of the opinion categories.

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